Progress Report of the Imperial Forest School for 1888-89

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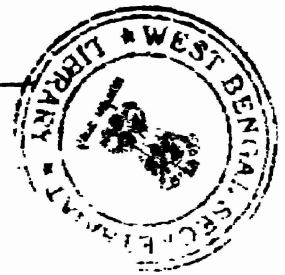

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No. 41.

FROM

E. E. FERNANDEZ, ESQ.,

OFFG. DIRECTOR OF THE IMPERIAL FOREST SCHOOL,
DEHRA DÚN,

TO

THE INSPECTOR-GENERAL OF FORESTS
TO THE GOVERNMENT OF INDIA.

Dated Dehra Dún, the 18th July, 1889.

SIR,

I HAVE the honour to submit herewith the Progress Report of the Imperial Forest School for 1888-89. The delay that has occurred in its submission is due to Colonel Bailey's illness having prevented him from writing it, and to my being unable to take it up before my return from Jaunsár.

I have the honor to be,

SIR,

Your most obedient servant,

E. E. FERNANDEZ,

Offg. Director, Imperial Forest School.

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Progress Report of the Imperial Forest School for 1888-89.

CHAPTER I.—The School Staff.

1. Mr. Fisher continued to officiate as Director from the beginning of the year until 1st January, 1889, when he obtained furlough for two years; Mr. Fernandez, Deputy Director, then acted as Director, in addition to carrying on his own duties, until he was relieved by the permanent incumbent, Lieutenant-Colonel F. Bailey, R.E., who returned to the School on the 16th January, 1889, after an absence of nearly five years.

The Deputy Directorship was held by Mr. Smythies from the beginning of the year up to 31st May, when Mr. Fernandez returned from his deputation as Assistant Inspector-General and resumed charge of his former duties. Mr. Fernandez was confirmed in the post on 29th December, 1888, *vice* Mr. Fisher, promoted to Conservator, 3rd grade.

Dr. Warth was Instructor throughout the year.

2. Besides the above officers, who composed the regular staff of the School, the following also took part in the instruction during the Rainy Season Term, from 1st July to 31st October, 1888:—

Mr. A. Smythies, Deputy Conservator of Forests, in charge of the Dehra Dún Division.

Mr. L. Mercer, Assistant Conservator of Forests, in charge of the Saháranpur Division.

Mr. J. F. Duthie, Director of Botany, Northern India.

Mr. E. C. Cotes, Assistant to the Superintendent, Indian Museum, Calcutta.

Messrs. T. and J. Marten, Forest Surveyors, under the direction of Mr. Reynolds, Superintendent of Forest Surveys.

Mr. A. Descubes, Forest Surveyor.

Forest Ranger Harswarup, I.

Laboratory Assistant Birbal.

Babu Kalipada Sirkar, Head Master of the Mission School, Dehra Dún.

3. The subjoined statement gives the names of the instructors in the several subjects and the amounts of the honoraria paid to them. The Director, Deputy Director and the Instructor, being specially School officers, received no honoraria.

Name of Instructor.	Subject taught.	Amount of honoraria.	Remarks.
The Director	Vegetable Morphology and Physiology ...		
„ Deputy Director ...	Forestry, Forest Zoology and for a few days Forest Engineering.	...	School officers.
„ Instructor	Physical Science, Surveying and Forest Engineering.		
Mr. Smythies	Mathematics	200	
„ Mercer	Forest Law	100	
„ Duthie	Systematic Botany	150	
„ Cotes	Entomology	300	
„ Reynolds with his two Assistants.	Map drawing	500	
Mr. Descubes	Plan drawing	200	
Forest Ranger Harswarup, I ...	Botany and Forestry in Hindustáni ...	80	
Babu Birbal	Physical Science ditto ...	40	
Babu Kalipada Sirkar ...	Mathematics ditto ...	60	
3 Goorkha Havildárs ...	Drill	60	

CHAPTER II.—Attendance of Students.

4. *Failed men of preceding year retained for re-examination.*—These were seven in number, and included, besides the six men whose names are given at the top of page 9

of the Progress Report for 1887-88, one more man, Eggya Narayan Shastri, who, not being satisfied with the forester's certificate awarded him, was specially allowed to remain at the School and be re-examined for the rangers' certificate in March, 1889.

5. *Senior Rangers' class.*—This class consisted of the same men who formed the junior class of the preceding year, *minus* one man, Israul Hak, who was sent back to his Province, and *plus* Mr. T. N. Hearsey, who returned from his Presidency on 1st July. Mr. E. Haslett, one of the private students, was appointed a Probationary Ranger of the Central Circle, North-Western Provinces and Oudh, in September.

The following left during the course of the year :—

H. W. Down, private student, in June.

F. W. Harris, private student, in August.

C. Litchfield, private student, in November.

E. Powell, private student, remanded to junior class in January.

6. *Junior Rangers' class.*—In accordance with para. 7 of the printed conditions of admission to the Forest School, an Entrance Examination was held in June, at which 31 candidates presented themselves with the following results :—

Class of candidates.	Number examined.			Number passed.		
	Style of living.		Total.	Style of living.		Total.
	European	Native.		European.	Native.	
Government	4	16	20	2	12	14
From Native States	...	2	2	...	2	2
Private	6	3	9	2	3	5
Total ...	10	21	31	4	17	21

The papers set at this examination are given at the end of this Report as Appendix V.

Of the 21 men who passed, the undermentioned did not join the School :—

Government candidates { Netra Ballab Tiwari, Central Circle, North-Western Provinces and Oudh. / Rajendra Lal Shaw, Central Provinces. / Rama Rao (Forester), Southern Circle, Madras. / Alagiri Swami Naidu.

Private candidates ... { Raghunath Sanwal, North-Western Provinces and Oudh. / Kasumri Das, Pattiala. / Jiva Ram, doing practical work in Dehra Dún.

7. The following private candidates were admitted as a special case ; that is, however, not to form a precedent :—

W. A. Hearsey, North-Western Provinces.

A. C. Watts, Travancore.

S. J. D. Spread, North-Western Provinces.

8. The five following candidates were admitted without examination :—

S. G. Paranzpe, B.A., Probationary Sub-Assistant Conservator, Central Provinces.

N. C. McLeod, ditto ditto ditto.

C. B. Anthony, ditto ditto ditto.

A. Tatham, Probationer, Ceylon.

J. St.L. Hansard, ditto.

Messrs. Paranzpe and McLeod were admitted on the ground that the former was a graduate in Arts of the Calcutta University and that the latter had passed into the Engineers' class at Roorkee and had gone through the entire two years' course there. Mr. Anthony was allowed to attend the courses on condition that he passed in Mathematics later on. The case of the students from Ceylon was treated as a special one. The number of men in the class, originally 25, was reduced to 24 in July by the return of Mr. Woutersz to Madras under medical orders, and to 21 in November by the resignation of Mr. Spread and the withdrawal of Messrs. McLeod and Anthony, whose services were urgently required in their own Province.

9. *The Foresters' classes, Junior and Senior.*—No special remarks required.

10. A nominal list of the students who were at the School during the whole or part of the year under report is given in Appendix I. Subjoined is an abstract of this list showing the attendance from the various Provinces, Circles or States :—

Province, Circle or State.	Rangers' course.									Foresters' course.				Total for each Circle.
	Men of the previous year who had failed to pass in March, 1888.			Senior.			Junior.			Senior.		Junior.		
	Probationary Sub-Assistant Conservators.	Rangers.	Foresters and others.	Probationary Sub-Assistant Conservators.	Rangers.	Foresters and others.	Probationary Sub-Assistant Conservators.	Rangers.	Foresters and others.	Men holding Middle Class certificates.	Others.	Men holding Middle Class certificates.	Others.	
Government of India — Bengal	1	...	...	2	...	2	...	...	...	...	...	...	...	5
N.-W. Provinces and Oudh,	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Central Circle ...	...	...	...	..	2	...	...	1	...	1	...	...	...	4
Oudh „ ...	...	...	...	...	1	1	...	...	1	...	...	.	...	3
School „ ...	..	...	...	...	...	...	...	...	2	...	1	...	...	3
Panjáb ...	...	...	2	...	...	2	...	...	2	...	...	1	...	7
Central Provinces	...	...	...	1	...	...	3	...	1	3	...	...	...	8
Burma ...	...	...	...	1	...	...	...	...	...	...	...	...	...	1
Assam ...	...	...	...	...	...	...	...	1	...	...	...	...	...	1
Total ...	1	...	2	4	3	5	3	2	6	4	1	1	...	32
Govt. of Madras. — Northern Circle ...	...	...	...	2	1	4	...	...	1	...	...	...	...	8
Southern „ ...	...	...	2	...	...	3	1	2	...	...	...	...	...	8
Total ...	...	...	2	2	1	7	1	2	1	...	...	...	...	16
Ceylon	...	...	...	...	...	...	2	...	...	...	...	...	...	2
Native States. — Jeypore	...	1	...	...	...	...	...	...	...	...	...	...	...	1
Patiala	...	...	...	...	...	2	...	...	...	...	...	...	...	2
Sirmor	...	...	...	...	...	...	...	...	...	...	...	1	...	1
Bilaspur	...	...	...	...	...	...	...	...	...	...	...	1	...	1
Alwar	...	...	...	...	...	...	...	...	2	...	...	...	...	2
Total ...	...	1	...	...	...	2	...	...	2	...	...	2	...	7
Private students ...	...	...	1	...	...	5	...	...	6	...	...	...	...	12
GRAND TOTAL ...	1	1	5	6	4	19	6	4	15	4	1	3	...	69

11. The following is an abstract by totals according to the mode of living of the students:—

	Number of students.							
	Government.		Native States.		Private.		Total.	
	European.	Native.	European.	Native.	European.	Native.	European.	Native.
Rangers' course, Failed men allowed to try again,	2	3	...	1	...	1	2	5
Rangers' course, Senior	9	13	...	2	5	...	14	15
Rangers' course, Junior	6	11	...	2	5	1	11	14
Foresters' course, Senior	...	5	...	...	...	...	...	5
Foresters' course, Junior	...	1	...	2	...	...	...	3
Total	17	33	...	7	10	2	27	42

12. The increasing number of private students is noteworthy. From having been *nil* only a few years ago, it was 12 per cent. in 1887-88 and nearly 18 per cent. in the year under report. This rapid increase has taken place in spite of the extremely restricted field for appointment and promotion offered by the Forest Department. There can be no doubt that, when the Sub-Assistant and Extra Assistant classes are organized on a proper footing, there will be no need to entertain stipendiary candidates at all for the recruitment of those classes.

CHAPTER III.—The Courses.

13. The year was divided into—

I.—The Spring Term, from 1st April to 31st May.

II.—The Rainy Season Term, from 1st July to 31st October.

III.—The Cold Weather Term, from 1st November to 31st March.

The usual vacations, respectively, of one month from 1st to 30th June, and of a fortnight from 22nd December to 3rd January, were observed.

I.—The Spring Term, from 1st April to 31st May.

14. The Deputy Director alone taught throughout this term. The students with him comprised those of the Junior Rangers' and Junior Foresters' classes, the six men of the Senior Rangers' class, who had failed in the final examinations held in the preceding March and had been retained for re-examination in the following July, having been deputed on some practical work under the orders of the Deputy Conservator in charge of the Dehra Dún Division.

15. The whole of this term was occupied by the tour to the hill forests of the Jaunsár Division. There was no class instruction given in camp, but the students were taken out every day into the forests or to works, and their attention was drawn to useful or interesting points, which were thoroughly explained to them on the ground. In this tour the following subjects were illustrated and studied:—

1. The boom across the Jumna at Dághpathar and the system of catching and landing sleepers floated singly from the hills above.
2. The management of a depôt for timber in transit.
3. The rafting of timber on the Jumna.
4. The management of fuel coppices at the foot of the Himalayas.
5. The management of oak coppices at an elevation of 4,500 to 6,000 feet.
6. Management of the forests (oaks and firs) of the Deoban Working Circle under the régime of Mr. Hearle's working plan.
7. Management of the Mundáli deodár forests under the régime of Mr. Fernandez's working plan.
8. Tapping of the long-leaved and blue pines for resin.
9. Management of forests of the long-leaved pine.

10. Management of the Tilri-Garhwál leased deodár forests, under the régime of Mr. Hearle's working plan.

11. The reproduction of deodár generally.

12. Timber transport in mountain forests, on coolies' heads, on mules, by sledge roads, by wet slide and by small mountain streams.

13. The felling and conversion of trees on steep mountain slopes.

II.—Rainy Season Term, from 1st July to 31st October.

16. Saturdays and Sundays were, as usual, holidays for the Rangers' class, while the Foresters' class spent three hours every Saturday in one of the divisional offices, in order to study the system of correspondence and accounts. From Monday to Friday the hours of instruction were distributed as follows :—

From	To	Number of hours.	Rangers' class.		Foresters' class.	
			Junior.	Senior.	Junior.	Senior.
6. A.M. ...	7. A.M. ...	1	...	...	Mathematics ...	Mathematics.
7 „ ...	8½ „ ...	1½	Map Drawing ...	Plan Drawing ...	Map Drawing ...	Map Drawing.
8½ „ ..	9½ „ ..	1	Vegetable Morphology and Physiology.	Forestry ...	Vegetable Morphology and Physiology.	Vegetable Morphology and Physiology.
9½ „ ...	10 „ ..	½	Ditto ...	Ditto ...	Interval ...	Interval.
10 „ ...	12 P.M. ...	2	Interval ...	Interval ...		
12 P.M. ...	1 P.M. ..	1	Mathematics	Forest Engineering.	Forestry ...	Forestry.
1 „ ...	2 „ ...	1	Forestry on Mondays, Wednesdays and Fridays; Physical Science on Tuesdays and Thursdays.	Forest Zoology, or Systematic Botany.	Forestry on Mondays, Wednesdays and Fridays; Physical Science on Tuesdays and Thursdays.	Forestry on Mondays, Wednesdays and Fridays; Physical Science on Tuesdays and Thursdays.
2 „ ...	3 „ ...	1	Physical Science,	Law ...	Physical Science,	Physical Science.
3 „ ...	4 „ ..	1	Drill on Tuesdays and Thursdays.			

17. The number of hours per week devoted to the several subjects were as shown below :—

Subject.	Rangers' class.		Foresters' class.		Remarks.
	Junior.	Senior.	Junior.	Senior.	
Forestry	3	7½	7	7	
Vegetable Morphology and Physiology.	7½	...	5	5	
Physical Science	7	...	7	7	
Forest Zoology or Systematic Botany.	...	5	...	...	
Law	...	5	...	...	
Mathematics	5	...	5	5	
Forest Engineering	...	5	...	...	
Drawing	7½	7½	7½	7½	
Drill	2	2	2	2	
Office work	...	...	3	3	
Total ...	32	32	36½	36½	

It had been intended to devote one hour a day for two months to Forest Zoology, and one hour a day for the remaining two months to Systematic Botany. But Mr. Duthie was able to give only five lectures when he was recalled to accompany the military expedition to the Black Mountain. As all the other instructors were fully occupied, it was found impossible to continue Mr. Duthie's course. On the other hand,

the course of Forest Zoology was extended beyond the prescribed two months. At first it was expected that Mr. Cotes would arrive in time to begin the subject on 1st July; but when a week of the term had elapsed, information was received that the Indian Museum could not spare his services, and Mr. Fernandez therefore took up the subject. When, however, towards the end of August he had completed the subject of the mammalia and insects, it was found that Mr. Cotes would after all come. This gentleman lectured for six weeks which he devoted exclusively to his special subject of Entomology.

18. Mr. Fernandez carried on the instruction in Forest Engineering for a little over a week, when, having to undertake that in Forest Zoology, he had to hand it over to Dr. Warth.

Dr. Warth was unable to complete either the Physical Science or the Engineering courses, about 15 lectures remaining undelivered in the former and eight in the latter.

In Mathematics Mr. Smythies made only a commencement in statics. Finding this subject beyond the comprehension of the majority of the students, he had to give it up.

In other respects the instruction during the rainy season of 1888 was of the same character and covered the same ground as during the preceding year.

19. After the preceding explanations, the following statement showing the number of hours devoted to each subject and the progress made in it during the term will be understood :—

Subject.	Number of hours.		Progress.
	English.	Urdu.	
Forestry	129	125	Sylviculture nearly completed.
Vegetable Morphology and Physiology ...	123	60	Morphology completed, physiology just begun.
Physical Science	105	116	Fifteen lectures remaining.
Forest Zoology	65	...	Completed.
Systematic Botany...	5	...	Only five lectures delivered and subject given up
Law	38	10	Completed.
Mathematics	54	70	Completed.
Forest Engineering	60	...	Eight lectures remaining.
Drawing	126	126	Completed.
Drill	30	30	Completed.
Office work	...	54	Completed.

III.—The Cold Weather Term, from 1st November to 31st March.

20. *Senior Rangers' class.*—This class remained out in camp during the whole time with the Deputy Director. The lectures in sylviculture were completed and those in utilization were begun and completed. The period from 3rd November to 22nd December was passed at Phandonwala, where the forest operations described in the lecture tent were illustrated on the ground. As the students had also to make fresh surveys as part of their final examination in Surveying, much time was lost that would have been more usefully employed in learning Forestry. The practice of making these fresh surveys will, accordingly, now be discontinued. Owing to the Deputy Director having had to carry on the duties of Director and of Conservator of Forests, School Circle, in addition to his own, until relieved by Colonel Bailey, on 15th January, the usual visit to some of the Panjáb forests was delayed by 10 days. This delay did not, however, cause any inconvenience, as with the concurrence of Colonel Bailey, who had only just left the Panjáb, the trip to the Pabbi reboisement operations, which have not proved successful, was left out of the programme. On return from the Panjáb, the Saháranpur forests between the Ganges and Dhaulkhand and the Siwalik forests of the Dehra Dún Division between that river and Phandonwala were visited. Under superior orders no instruction was given on the subject of working plans. In future, however, a very

limited course will be worked into the curriculum, just sufficient to enable the men to understand the meaning and object of any working plan they may have to carry out, and to assist in the collection of data for new working plans. In the latter half of February Dr. Warth delivered his remaining lectures in Forest Engineering.

21. The last week of March, after all the final examinations had been completed, was spent by the students in skinning, preserving and mounting birds. The authorities of the Indian Museum very kindly placed one of their taxidermists at the disposal of the Forest School. The course of Taxidermy will be continued every year, and in this manner both the Indian Museum and the Forest School will have numerous well-taught collectors in every part of the Empire.

22. *Junior Rangers' class.*—As proposed in last year's report, the Surveying course was held at Dehra. It extended from 1st November to 18th February, the intervening fortnight's vacation during Christmas being of course excluded. It will be remembered that during the preceding year the course was completed by 22nd December, so that the course given in the year under report was nearly twice as long again. This extension of the course was required for three reasons :—(i) the time given to it during the previous year was proved to be inadequate by the fact that only 10 months later many of the men remembered very little of what they had been taught; (ii) none of the men had been able to complete the amount of work prescribed by section 52 of the Forest Department Code for the Lower Standard certificate; and (iii) it was resolved to avoid the great inconvenience and loss of time referred to in para. 20 and to have in future no heavy Surveying work clashing with the instruction in Forestry. Dr. Warth had entire charge of the Surveying course. While it was in progress he completed his lectures in Physical Science and taught the class blasting for three days at a place just beyond the lines of the 2nd Battalion of the 2nd Goorkhas, where works are in progress to bring down water to those lines.

23. On the 20th February the class joined the Deputy Director at Phandonwala, where the rest of the term was spent in attending lectures in Forestry in the lecture tent and in seeing sylvicultural operations illustrated in the surrounding forest.

24. In this term an important and much needed change was introduced into the practical outdoor teaching of Forestry. Hitherto it had been the custom to take over a definite area of the annual coupes of the Dehra Dún forests and to get the class to carry out in it the prescribed operations under the authority and responsibility of the Divisional Officer. This system involved three capital disadvantages. In the first place, correct and efficient teaching was not guaranteed, for even if the Deputy Director remained with the students the whole of the time, it was necessary to complete the work over a certain considerable area every day, and it was therefore impossible to conduct each operation in the leisurely manner and with the full detailed explanations which alone can ensure successful teaching, especially with the stamp of men composing the majority of the class. In the second place, the work done in the division is not varied enough to illustrate all or even most of the operations taught in the lecture room; and in the third and last place, with so many men working together, there was no individual responsibility, without which there is no guarantee for good, or at least conscientious, work. Under the system now adopted the teacher, in consultation with the Divisional Officer, selects one or more small areas, conveniently situated and affording every facility for instruction. In these areas only a little work is got through every day, but this little amount is done thoroughly and no tree is marked for felling or is preserved or cut without its case being thoroughly studied *vivâ voce*, from every point of view, by the teacher directly or by the students under the guidance of the teacher. The new system of outdoor teaching thus draws out and trains the observing faculties of the students and leaves definite and permanent impressions on their minds. The improvement felling coupes in the Dehra Dún forests offer at their different points every variety of elementary felling operations; these can therefore be fully studied by the students both independently and relatively to their bearing on precedent or consequent elementary operations.

The new system of outdoor teaching enabled Mr. Fernandez to complete the whole of Sylviculture in this term, a result that has never yet been attained before. It will hence be possible during the Rainy Season Term of 1889 to take the class rapidly through the entire subject once again, so as thoroughly to impress its main principles on their minds.

25. *The Senior Foresters' class.*—The men of this class accompanied Mr. Fernandez into camp with the Senior Rangers' class. They completed their course on 22nd December and were then examined for their certificates.

26. *The Junior Foresters' class.*—This class remained with Dr. Warth, learning Surveying and Levelling along with the Junior Rangers' class, from 1st November to the beginning of the Christmas vacation. They then joined Mr. Fernandez, accompanying him, with the Senior Rangers' class, to the Panjáb and to the forests of the Saharanpur Division and doing the same outdoor work as that class. As they spent only seven weeks with Dr. Warth learning Surveying, they will have to go through a further course in November next in order to complete the amount of work prescribed by the Forest Department Code for the Lower Standard certificate.

CHAPTER IV.—The Final Examinations and the Certificates and Prizes awarded.

27. The final examinations were conducted and superintended entirely by the School officers. They were held in the following order:—

For the Ranger's certificate.

	Special second examination in Forestry for the six students who had failed in March, 1888 *(viva voce)*	14th July, 1888.
The regular examinations	In Law *(viva voce)*	1st October, 1888.
	Mathematics (paper)	27th September, 1888.
	Forest Zoology (paper and *viva voce*)	12th and 13th October, 1888.
	Physical Science *(viva voce)*	26th and 27th October, 1888.
	Surveying	10th and 15th December, 1888.
	Vegetable Morphology and Physiology	16th, 18th and 19th March, 1888.
	Special second examination in Mathematics for one student who had failed at the regular examination in September ...	5th March.
	Special second examination in Physical Science for four students who had failed in October, 1888	28th February, 1889.
	Special second examination in Forest Zoology for three students who had failed in October, 1888, this being also the first examination for two students who had been prevented by illness from attending the examination in October ...	6th March, 1889.
	Special second examination in Law for one student who had failed at the regular examination in October, 1888	7th March, 1889

For the Forester's certificate.

The regular examinations.	In Mathematics	27th October, 1888
	„ Physical Science and Botany	29th October, 1888.
	„ Surveying	16th December, 1888.
	„ Forestry	22nd December, 1888.
	Special second examination in Mathematics for one student who had failed in October, 1888	19th December.
	Special second examination in Physical Science and Botany for two men who had failed in October, 1888	21st December.
	Special third examination in Physical Science and Botany for one student who had failed in October and in December ...	7th March.
	Special second examination in Forestry for one student who had failed in December	23rd March.

Appendix VI contains the questions or heads of questions set at these final examinations.

There was no examination in Systematic Botany, as only a very small portion of the subject had been taught (see para. 17).

28. As a result of the above examinations the following certificates and prizes were awarded:—

The Ranger's certificate.

Running number.	Name of Student.	Province, Circle or Native State from which deputed.	Separate subjects in which the student passed with honours.	Prizes won.			Remarks.
				Subject.	Donor.	Value.	
						Rs.	
			DATE OF CERTIFICATE, 14TH JULY, 1888.				
1	Chhaju Ram ...	Panjáb ...	See Report for 1887-88 ...	...	...	...	All these men failed to obtain their certificates at the regular examinations in March, 1888.
2	Imam-ud-din ...	Ditto ...	Ditto ...	...	...	...	
3	Slane, E. E. ...	Bengal ...	Ditto ...	...	...	...	
4	Surappa Iyer ...	S C., Madras,	Ditto ...	...	...	...	
5	Tapp, J. ...	Ditto ..	For prizes and honours gained by this student see Progress Report for 1887-88.	...	...	...	
			DATE OF CERTIFICATE, 31ST MARCH, 1889.				
			CERTIFICATE WITH HONOURS.				
1	V. Alwar Chetty, B.A.	N. C., Madras,	Forestry, Vegetable Morphology and Physiology, Surveying, Mathematics, Physical Science, Law, Engineering, Zoology.	Forestry, 2nd prize.	Government	30	
				Surveying ..	Ditto ...	25	
				Physical Science,	Ditto ...	20	
				Engineering ..	Ditto ...	20	
				Zoology (1 prize),	Ditto ...	15	
			ORDINARY CERTIFICATE.				
1	Achhru Ram ...	Patiala ...	None	...	...	...	
2	Calderwood, D. K.,	Burma ...	Forestry, Mathematics, Engineering, Zoology.	Forestry ...	Mr. Moir ..	30	Passed in Law only on 7th March, having failed in October.
3	Eggia Narayan Shastri.	Private student.	None	...	...	...	
4	Hearsey, T. N. ...	N. C., Madras,	Do.	...	...	...	Passed in Mathematics only on 5th March, having failed in September.
5	Hobday, J. J. ...	Central Provinces.	Forestry, Vegetable Morphology and Physiology, Law, Engineering, Zoology.	Forestry (1st prize).	Director ..	50	
				Vegetable Morphology and Physiology.	Government,	30	
				Zoology (1 prize),	Ditto ..	15	
6	Jagat Ram ...	Panjáb ...	Mathematics ...	...	...	...	
7	Kamr-ud-din ...	Patiala ...	None	...	...	...	
8	Mascarenhas, E. C.,	S. C., Madras,	Vegetable Morphology and Physiology.	...	...	...	
9	McCay, W. R. ...	N. C., Madras,	Vegetable Morphology and Physiology, Engineering.	...	...	...	
10	Nand Lal ...	Panjab ..	None	...	...	...	Passed in Zoology only on 6th March, having failed in October.
11	Navo Kumar Seth,	Bengal ..	Vegetable Morphology and Physiology, Mathematics.	Mathematics ..	Government,	15	
12	Quinnell, R. ...	Ditto ..	Law	Law ...	Ditto ..	15	
13	Raghuvans Sahai,	Oudh, N.-W P. and Oudh.	Mathematics, Physical Science, Law.	...	...	...	
14	Ryan, J. W. ...	S. C., Madras,	Law	...	...	...	
15	Subramania Iyer,	Ditto ..	Do.	...	...	..	

The Forester's certificate.

Running number.	Name of student.	Province, Circle or Native State from which deputed.	Remarks.
1	Akbar Ali ...	School Circle, North-Western Provinces and Oudh.	Passed in Mathematics only on 19th December and in Physical Science on 21st December.
2	Arjun Singh ...	Central Provinces ...	Passed in Physical Science only on 7th March, and in Forestry on 23rd March.
3	Jodh Singh ...	Central Circle, North-Western Provinces and Oudh.	
4	Kundan Lal ...	Central Provinces.	
5	Mukat Bihari Lal ...	Ditto.	
6	Radha Kishan ...	Jeypur ...	Tried unsuccessfully for Ranger's certificate in March, 1888, and again on 14th July, 1888.

The prize for the best herbarium, of the value of Rs. 50 presented by "an Old Student," was awarded to Mr. C. Litchfield, who left the school in November to take up an appointment as a Probationary Forest Surveyor.

29. The following students failed to obtain their certificates during the year :—

Running number.	Name of students.	Province or circle from which deputed.	Subjects in which failed.	Remarks.
		To be examined in July, 1889.		
1	Arokiaswami Pillai...	Northern Circle, Madras.	Forestry.	
2	Brindaban Chandra Ghoshal.	Bengal ...	Ditto and Vegetable Morphology and Physiology.	
3	Haldane, C. ...	Private student ...	Forestry ..	Passed in Physical Science only in March, having failed at the regular examination in October.
4	Hanumanthulu ...	Northern Circle, Madras.	Vegetable Morphology and Physiology.	Passed in Physical Science and Zoology in March, having failed at the regular examination in October.
5	Haslett, E. ...	Central Circle, North-Western Provinces and Oudh.	Ditto and Forestry.	
6	James, E. J. N. ...	Bengal ...	Forestry.	
7	Kampta Prasada ...	Oudh Circle, North-Western Provinces and Oudh.	Vegetable Morphology and Physiology.	
8	Prasadi Lal ...	Central Circle, North-Western Provinces and Oudh.	Ditto.	
9	Ratnaswami Pillai ...	Northern Circle, Madras.	Forestry ..	Same remarks as against Hanumanthulu.
		Sent back without any certificate at all.		
1	Raghavaya, C. ...	Northern Circle, Madras.	Forestry, Vegetable Morphology and Physiology, Engineering and Zoology.	

CHAPTER V.—General Remarks.

Athletics.

30. The native students were put through two hours' drill every week by non-commissioned officers of the 2nd P. W. O. Goorkhas, while the European and Eurasian students had to attend the two weekly drills of the Dehra Dún Mounted Rifles. Cricket and lawn tennis were encouraged as much as possible, but it is to be regretted that the native students as a body did not take kindly to either of these healthful modes of taking exercise.

31. Sports were held as usual on the parade ground in front of the School at the close of the Rainy Season Term, and prizes were awarded as follows :—

Description of event.	Winners.
Three-legged race ...	1. A. Tatham. 2. R. Quinnell.
Throwing the cricket ball	1. A. Tatham.
100 yards' race ...	1. A. Tatham. 2. W. R. Scott.
Broad jump	1. T. N. Hearsey.
220 yards' race for native students only ...	1. Prithvi Singh. 2. Ratnaswami Pillay.
High jump ...	1. J. Hobday. 2. W. R. McCay. 3. C. Litchfield.
Hurdle race ...	1. J. W. Ryan. 2. C. Litchfield.
Three-quarter mile race ...	1. W. R. McCay. 2. Prithvi Singh. 3. C. Litchfield.
Putting the shot ...	1. N. C. McLeod.

There was also a foot hurdle race for the troopers of the Viceroy's Body Guard and a race in full marching order for the riflemen of 2nd P. W. O. Goorkhas, the band of the 2nd Battalion of which regiment was kindly lent for the occasion by the Commanding Officer.

Health of the students.

32. There was no epidemic of any kind this year, and the health of the students was generally excellent. During the latter half of the Cold Weather Term the Hospital Assistant attached to the Jaunsár Division remained with the students out in camp in the Dún, while during the Rainy Season Term at Dehra the Hospital Assistant attached to the Great Trigonometrical Survey attended every morning at the School. Since the close of the year sanction has been received for the entertainment of a special Hospital Assistant for the School throughout the year.

Accommodation.

33. The second block of quarters for the students still remains to be built. Sanction for its construction for Rs. 14,505 has only just been received, and houses were hence hired as usual, involving a net charge to the Imperial Budget of Rs. 154 only, Rs. 87-11-1 having been recovered from the students occupying them. The rent of the completed block of residential quarters amounted to Rs. 397-1-6, which amount was paid to the Government of the North-Western Provinces and Oudh.

34. Very great inconvenience was suffered owing to the amount of accommodation taken up by the Forest Survey Office, both the Director's and Conservator's offices, which ought to be located in the School building, having had to be removed to a small house outside the grounds of the School. Orders have, however, now been received for the Forest Survey Office to remove into a separate building.

35. The addition of a new wing to the south side of the main building, estimated to cost Rs. 13,701, has been sanctioned and commenced. This will provide a lecture theatre on the ground floor and a long room upstairs.

Manuals.

36. During the year Mr. Fisher's "Manual of Morphological Botany" and Mr. Fernandez's "Rough Draft of a Manual of Indian Sylviculture" were completed and published. Mr. Hobart-Hampden's Notes on Forest Engineering are now ready for

press and may be in print for use during 1889-90. Mr. P. J. Carter, Deputy Conservator of Forests in Burma, is publishing in the *Indian Forester* excellent notes on the "Mensuration of Timber and Trees." These will be issued as a separate pamphlet and adopted as a text-book at the School.

As regards the teaching in Urdu, Parts I and II of Mr. Fernandez's course for candidates for the Forester's certificate have been published. They comprise respectively 198 and 100 pages and deal, the first with physics, chemistry, physical geography, climates and the formation and properties of soils, the second with the structure, growth and reproduction of plants. The treatment of the subject is very nearly comprehensive enough for the Ranger's course. Part III of the course, being the portion dealing with sylviculture, was all but completed in manuscript by the end of October, but proving to be very much more bulky than what was intended, it will be cut down and practically re-written during the current year.

Distinctions gained by passed students.

37. During the year the undermentioned passed students received promotion to the higher grades as follows :—

Year of certificate.	Name of student.	Promoted to—	On salary of—
			Rs.
1888	E. E. Slane ...	Sub-Assistant Conservator of Forests, Bengal.	150
1887	Jwala Pershad ...	Probationary ditto, Panjáb ..	100
1884	C. Ingram ...	Assistant Conservator, Burma ...	250
1887	E. M. Buchanan ...	Ditto ditto ...	250
1885	C. L. Toussaint ...	Ditto ditto ...	350
1887	Manbir Gurang ...	Deputy Conservator, Nahan State ...	100

Contributions to the Museum.

38. A list of these contributions will be found in Appendix IV. They are all of great value, and the best thanks of Government are due to the donors. Mr. Mann's and Mrs. Hearsey's gifts are peculiarly valuable.

The School Entrance Examination for admission to the Rangers' Class.

39. Reference has already been made in para. 6 to the entrance examination held in June, 1888. The institution of such an examination is an entirely new departure. In previous years students were, with hardly any exceptions, received at the School provided only they could furnish a certificate of having matriculated at any of the Indian Universities. Experience proved that a very large percentage of the men so admitted were insufficiently educated, and it was accordingly decided to hold every year a special entrance examination to test the qualifications of the candidates presenting themselves for admission. The question papers were sent out from Dehra on 1st June to the various Conservators and Native States requiring them. The examinations were held not only at the headquarters of the circles, but also at the headquarters of the civil districts in which the candidates were living. In the case of the more remote centres of examination the papers were received too late to be given out in time, and as the papers were given out as they arrived, the examinations were held on different dates at the different centres. These two drawbacks have since been provided against by issuing the papers in April and holding the examinations simultaneously all over India on one and the same date early in May.

The object of the entrance examination is, as said before, to ensure of none but qualified candidates being admitted into the School. Judged from this point of view, the examination held in June, 1888, failed from having been too easy. It weeded out, it is true, all who were absolutely bad, but, as already stated in para. 18, most of those whopassed did not know mathematics well enough to be taught statics, while many of them are not sufficiently conversant with either colloquial or written English. An

insufficient acquaintance with mathematics can be remedied by setting more difficult questions, but men who do not know English well enough can be kept out only by the co-operation of the officers who have to certify that the candidates are able to write and speak the language fluently and correctly and understand it readily and accurately when spoken to by an Englishman.

Insufficiency of the present School Staff.

40. The most important step of progress during the year was the change introduced into the system of outdoor teaching in the Dún forests, and referred to in para. 60. This change will not, however, bear full fruit until the Deputy Director is aided by another instructor. The least number of students he has with him at any time exceeds 30, comprising one English and one vernacular class.

41. Thirty men, divided into two separate classes, are already too many for a single teacher, seeing that he alone has to keep all the men fully employed during the entire working day of six hours. But during at least one month of the Cold Weather Term the Deputy Director has under his own unaided tuition the two remaining classes also, that is to say, all the students present at the School, aggregating about 60 men. Besides having to teach, singlehanded, this large body of men divided into four several classes, he has also to look after their discipline and the thousand and one little matters that constantly arise in the management of a large school on tour. So much work cannot obviously be efficiently performed by a single officer, and even its continued inefficient performance under such circumstances depends on the mere accident of this one individual remaining in good health throughout the seven months of the camping season. Thus under the present organization of the School a complete breakdown of the entire teaching is always a likely occurrence, and we can only thank our rare good fortune that no breakdown has yet occurred. Such a state of things should obviously not be allowed to continue, and it is hoped that the least Government will be able to do will be to appoint at once a trained Forest Officer of experience and ability in place of Dr. Warth, who is away on 18 months' furlough. A separate communication will be made on this very pressing matter.

E. E. FERNANDEZ,
Offg. Director, Forest School.

APPENDICES.

APPENDIX I.

Nominal List of students who attended the School during the whole or part of the year.

Number.	Names.	Grade.	University or other qualifying examination passed.	Province or Circle.	Remarks.
		RANGER'S COURSE.			
		Men who had failed to obtain the certificate in March, 1888.			
1	Chhajju Ram ...	Forester ...	Entrance, Panjáb ...	Panjáb.	
2	Imam-ud-din ...	Ditto ...	Ditto ...	Ditto	
3	Radha Krishna ...	Forest Apprentice ...	First Arts, Calcutta,	Jeypur State.	
4	E. E. Slane ...	Prob. Sub-Assistant Conservator.	None ...	Bengal.	
5	Surappa Ayer ...	Forester ...	Matriculation, Madras.	Southern Circle, Madras.	
6	J. Tapp ...	Ditto ...	Ditto ...	Ditto.	
7	Eggya Narayan Shastri.	Private Student ...	Ditto ...	...	
	Government Students.		*Second year's class.*		
1	E. J. N. James ...	Pro. Sub-Assistant Conservator.	None ...	Bengal	
2	R. Quinnell ...	Ditto ...	Ditto ...	Ditto,	
3	D. Calderwood ...	Ditto ...	Ditto ...	Burma.	
4	J. J. Hobday ...	Ditto ...	B. A. Examination, Madras.	Central Provinces.	
5	V. Alvar Chetty ...	Ditto ...	Ditto ...	Northern Circle, Madras.	
6	T. N. Hearsey ...	Ditto ...	None ...	Ditto.	
7	Mr. W. R. McCay ...	Forest Ranger ...	Ditto ...	Ditto.	
8	Prasádi Lal ...	Prob. Forest Ranger,	Entrance, Calcutta...	Central Circle, North-Western Provinces.	
9	E. L. Haslett ...	Ditto ...	Ditto ...	Ditto.	
10	Raghuvans Sahai ...	Ditto ...	Ditto. ...	Oudh Circle, North-Western Provinces.	
11	Kampta Prasada ...	Forester ...	Ditto. ...	Ditto.	
12	Arokiaswami Pillai,	Ditto. ...	Matriculation, Madras.	Northern Circle, Madras.	
13	Hanumanthulu ...	Ditto ...	Ditto ...	Ditto.	
14	C. Raghavaya ...	Ditto ...	Ditto ...	Ditto.	
15	Ratnaswami Pillai ...	Ditto. ...	Ditto ...	Ditto.	
16	E. C. Mascarenhas ...	Ditto ...	Ditto. ...	Southern Circle, Madras.	
17	J. W. Ryan ...	Ditto. ...	Ditto. ...	Ditto.	
18	C. Subramania Iyer,	Ditto ...	Ditto. ...	Ditto.	
19	Brindabau Chandra Ghoshal.	Ditto ...	Entrance, Calcutta...	Bengal.	
20	Nava Kumar Seth ...	Ditto ...	Ditto ...	Ditto.	
21	Nand Lál ...	Ditto. ...	Ditto ...	Panjáb.	
22	Jagat Ram ...	Ditto ...	Ditto ...	Ditto.	
	Students from Native States.				
1	Achru Ram ...	Forest Apprentice...	Entrance, Panjáb ...	Patiala State.	
2	Kamr-ud-din ...	Ditto ...	Ditto ...	Ditto.	
	Private Students.				
1	C. Haldane ...	...	School Entrance Examination.	...	
2	E. Powell ...	...	Ditto ...	...	Remanded to junior class in January, 1889.
3	F. W. Harris ...	...	School Entrance Examination for Sub-Asst. Conservators.	...	
4	H. W. Down ...	...	...	...	Left the School in August for appointment as Assistant Sub-Deputy Opium Agent.
5	C. Litchfield ...	...	...	...	Left the School in June. Got an appointment in the Forest Survey, Branch in November.

APPENDIX I.

Nominal List of Students, &c.—(concluded).

Number.	Names.	Grade.	University or other qualifying examination passed.	Province or Circle.	Remarks.
	Government Students.		*First year's class.*		
1	A. Tatham ...	Pro. Assistant Conservator.	...	Ceylon.	
2	J. St. L. Hansard ...	Ditto ..	...	Ditto	
3	N. C. McLeod ...	Pro. Sub-Assistant Conservator.	...	Central Provinces.	Returned to their Provinces in November.
4	C. B. Anthony ...	Ditto ...	...	Ditto.	
5	S. G. Paranzpe ...	Ditto ...	B. A. Examination, Calcutta.	Ditto.	
6	C. J. Woutersz ...	Ditto ...	...	Southern Circle, Madras.	
7	M. Rama Rao ...	Forest Ranger ...	...	Ditto.	
8	G. W. Thompson ...	Ditto ...	...	Ditto.	
9	Nilkanth Mukerji ...	Ditto ...	...	Assam.	
10	Krishna Nand Joshi,	Ditto ...	Entrance, Calcutta...	School Circle, N.-W. P. and Oudh.	
11	K. Rama Rao ...	Forester ...	Matriculation, Madras,	...	
12	D. Barrow ...	Ditto ...	...	Oudh Circle, N.-W. P. and Oudh.	
13	Gulab Rai ...	Forest Apprentice ...	Entrance, Calcutta...	School Circle, N.-W. P. and Oudh.	
14	Panna Lal ...	Ditto ...	Ditto ...	Ditto.	
15	Faiz Bakhsh ...	Ditto ...	...	Central Provinces.	
16	Nawazish Ali ...	Forester ...	...	Panjáb.	
17	Aruri Ram ...	Ditto ...	...	Ditto.	
	Students from Native States.				
1	Ajudhya Prasada ...	Forest Apprentice ...	Entrance, Calcutta...	Alwar State.	
2	Ram Chand ...	Ditto ...	Ditto ...	Ditto.	
	Private Students.				
1	W. R. Scott ...	...	School Entrance Examination.	Panjáb.	
2	A. William ...	...	Ditto ...	N.-W. P.	
3	W. A. Hearsey ...	...	None ...	Ditto.	
4	A. C. Watts ...	...	Ditto ...	Travancore.	
5	S. J. D. Spread ...	...	Ditto ...	N.-W. P. ...	Left the School in October.
6	Ananta Rama Iyengar.	...	School Entrance Examination.	Mysore.	
		FORESTER'S COURSE.			
	Government Students.		*Senior Class.*		
1	Jodh Singh ...	Forester ...	Middle Class ...	Central Circle, N.-W. P. and Oudh.	
2	Mukat Bihari Lal ...	Ditto ...	Ditto ...	Central Provinces.	
3	Arjun Singh ...	Ditto ...	Ditto ...	Ditto	
4	Kundan Lal ...	Ditto ...	Ditto ...	Ditto	
5	Akbar Ali ...	Ditto ...	None ...	School Circle, N.-W. P. and Oudh.	
	Government Students		*Junior Class.*		
1	Ghulam Haidar ...	Forester ...	Middle Class ...	Panjáb.	
	Students from Native States.				
1	Prithvi Singh ...	Forest Apprentice ...	Middle Class ...	Sirmor State.	
2	Teka Ram ...	Ditto ...	Ditto ...	Bilaspur State.	

APPENDIX II.

Statement showing the number of students who have passed out of the Forest School since the first course of instruction.

Year.	Number of students who have qualified.				Total certificated students.	Officers who attended only a portion of course.	Students who left without certificates.	Remarks.
	Sub-Assistant Conservator's certificate.	Ranger's certificate.		Forester's certificate.				
		With honours.	Ordinary.					
1881 ...	2	...	3	...	5	6	2	The certificate for Sub-Assistant Conservator was abolished in 1883.
1882 ...	1	...	3	1	5	10	...	
1883 ...	...	2	10	3	15	2	...	
1884 ...	...	2	12	1	15	3	1	
1885 ...	...	1	8	3	12	1	4	
1886 ...	...	4	14	8	26	...	6	
1887 ...	...	...	17	14	31	...	6	
1888 ...	...	1	15	6	22	...	1	
Total ...	3	10	82	36	131	22	20	

APPENDIX III.

Statement of total expenditure on the Forest School since its establishment to the end of March, 1889.

Items.	Expenditure to the end of March, 1888.	Expenditure from April, 1888, to March, 1889.	Total.
Capital Expenditure.	Rs.	Rs.	Rs.
Buildings	39,929	...	39,929
Observatories	4,279	58	4,337
Total ...	44,208	58	44,266
Annual expenditure at School.			
Salaries and Travelling Allowance of Officers and Establishments...	1,06,387	24,391	1,30,778
Special allowance of Director	13,036	2,400	15,436
Honoraria	11,795	1,460	13,255
Prizes	997	115	1,112
Stipends	3,587	...	3,587
Survey and drawing instruments	14,868	42	14,910
Chemicals and apparatus	3,329	...	3,329
Books and periodicals and diagrams	4,566	104	4,670
Miscellaneous (including museum, herbarium, laboratory, gardens and rent of houses, &c.).	24,367	4,391	28,758
Total ...	1,82,932	32,903	*2,15,835
GRAND TOTAL, including Capital Expenditure ...	2,27,140	32,961	2,60,101

* This gives Rs. 1,647 for each certificated student exclusive of the salaries paid to Government students.

A.—*Annual Expenditure debited to Provincial Budgets.*

Items.	Expenditure to end of March, 1888.	Expenditure from April, 1888, to March, 1889.	Total.
	Rs.	Rs.	Rs.
Government of Madras	35,841	9,273	45,114
Ditto Bengal	19,275	4,856	24,131
Ditto North-Western Provinces and Oudh... ...	10,026	3,165	13,191
Ditto Panjáb	22,809	1,727	24,536
Ditto Central Provinces	10,800	5,123	15,923
Ditto Assam	6,943	542	7,485
Ditto Burma	13,987	1,007	14,994
Ditto Ceylon	..	1,279	1,279
Ditto Berar	3,105	...	3,105
Ditto Coorg	2,581	...	2,581
Ditto Ajmír	664	...	664
Total ...	1,26,031	26,072	1,53,003
Native States—			
Baroda	3,094	...	3,094
Jeypur	5,351	210	5,561
Patiala	2,641	943	3,592
Pratábgarh	1,569	30	1,599
Mysore	4,006	...	4,006
Rewah	1,594	...	1,594
Sirmor	...	330	330
Total ...	18,263	1,513	19,776
GRAND TOTAL ...	1,44,294	28,485	1,72,779

B

Province or Circle.	Pay.	Travelling Allowance.	Total.	Remarks.
	Rs.	Rs.	Rs.	
Government of Madras	6,711	2,562	9,273	
Ditto Bengal	3,562	1,294	4,856	
Ditto North-Western Provinces and Oudh...	2,415	750	3,165	
Ditto Panjáb	1,175	552	1,727	
Ditto Central Provinces	3,797	1,326	5,123	
Ditto Assam	391	151	542	
Ditto Burma	799	207	1,006	
Ditto Ceylon	1,200	*79	1,279	* Includes cost of uniform, &c., supplied.
Total ...	20,050	6,921	26,971	
Native States—				
Jeypur	120	90	210	
Patiala	480	463	943	
Pratábgarh	30	...	30	
Sirmor	304	25	329	
Total ...	934	578	1,512	
GRAND TOTAL ...	20,984	7,499	28,483	

APPENDIX IV.

Gifts to the Museum received during 1888-89.

Number.	Name	Number of articles.	Name of articles.
1	Mr. W. R. Fisher	11	Sections of mahogany; 3 kinds of tassar silk and specimens of cocoons, and 6 shells from Berhampore, Bengal
2	Mr L Mercer	3	Elephant's head and 2 seals (old).
3	Colonel F. Bailey, R. E. . .	2	Decayed spotted wood of *Quercus incana* acted upon by water, from Chamba, and dried specimens of a Zizyphus
4	Manager, Lucknow Paper Mills Co,	4	Four kinds of fibres.
5	Mr A Campbell ...	2	Fibre and rope of Bhimal (Grewia sp) &c.
6	Mr. J. Duthie	4	Wood sections and cones of Abies Webbiana and Pinus excelsa from Black Mountain
7	Inspector-General of Forests ...	22	Twenty-two specimens of wood of different kinds.
8	Mr Hobart-Hampden ..	2	Head of sambar and Tibet cat.
9	Mrs. Andrew Hearsey	29	Specimens of birds (mounted).
10	Mr. Gustav Mann	10	Ten bundles dried specimens of about 200 Assam plants.
11	Anantarama Iyengar, private student of Mysore	2	Card case and fan of sandal wood.
12	Mr. G G Minniken .	...	Insects with larvæ
13	Mr. A E. Lowrie	2	Aonla fruit jar and sál butter.

APPENDIX V.

Entrance Examination.

I.—English Composition.

(Time allowed, 2½ hours.)

1. Re-write in your own words the following :—

Exchange has sunk to a point which it has never reached before. The price for on demand drafts in Calcutta yesterday was 1*s.* $3\frac{31}{32}$*d.* the rupee. As the fall has progressed each penny in the descending scale has been fixed upon in the public mind as the low-water mark beyond which the gold price of silver could not fall. It was a great blow to many anticipations when 1*s.* 8*d.*, which we should consider prosperity now-a-days, was passed. Then those who would expect the worst took their stand at 1*s.* 6*d.*, and since that position became untenable, 1*s.* 4*d.* has been the imaginary price at which compensatory influences must come into play. Yet once more the metal is on its downwards course, and there is no reason why the hypothesis of the books," suppose the rupee were worth no more than a shilling," selected for the sake of simplicity as an imaginary illustration, should not become one of these days a saddening reality—but for one fact. This last fall occurs simultaneously almost with the announcement from our London Correspondent that the Currency Commission will either show a draw between the two camps of opinion (or rather the camp of opinion and the camp of prejudice) or a 7 to 5 victory for the bi-metallic cause. It is evident that there is one member doubtful, and no one would envy him the responsibility of making up his mind if the Commission's vote were actually the decision of the national policy in so vital a matter. But of course a balance of opinion or a narrow majority among the Commissioners will not impose any necessity upon the Ministry which appointed them of taking any practical steps in accordance with their advice. One can hardly wish that it should. But the moral effect will be none the less immense. The mere appointment of the Commission was a recognition of bi-metallism, the value of which only those who had upheld the doctrine in its early days could appreciate. If the end of the inquiry is to show a balance of opinion for bi-metallism with all the prejudices of the English business world against it, it is a victory so striking that the subject will not allow of being set aside and dismissed without more consideration. And as it is said by the later

exponents of the creed that if the principles were once agreed upon and an arrangement arrived at by the principal nations, the difficult question of settling the precise ratio of the metal need not be considered, because the mere moral effects of the understanding would rehabilitate silver at the old $15\frac{1}{2}$ to 1; so in the same way we may trust that the knowledge of the drift of the Commission's views will at least suffice to save us from a one and three-penny rupee.

2. Write an essay on one of the following subjects :—

(*a*) The natural resources of India.
(*b*) Choice of a profession in India.
(*c*) Education for the masses in India.

II.—Arithmetic.

(Time allowed, $2\frac{1}{2}$ hours).

1. Define the terms *Greatest Common Measure* and *Least Common Multiple.*

Find the G. C. M. of 326,337 and 737,800, and the L. C. M. of 22, 55, 19, 15, 95 and 133.

2. Define the terms *Improper Fraction, Simple Fraction, Compound Fraction, Complex Fraction.*

Find the value of

$$9\tfrac{1}{2} \text{ of } 2\tfrac{1}{3} + \frac{13}{18} + \frac{\frac{2}{17}}{\frac{5}{17}} - (7\tfrac{1}{13} \div 1\tfrac{3}{11}).$$

3. Find the values of

(*a*) $4\cdot\dot{3}+3\cdot2\dot{3}-2\,0\dot{3}\dot{8}\dot{7}$

(*b*) $(0\cdot\dot{3}\dot{5}\dot{1} \times 0\cdot\dot{7}\dot{3}\dot{6}) \div (0\cdot2\dot{6}\dot{2}\dot{7} \div 1\cdot9\dot{2}\dot{6})$.

4. If 5 persons can be supported for 160 days on Rs. 1,000: how long can 12 persons be supported on Rs. 1,500 at a similar rate?

5. A gentleman invested seven lakhs and Rs. 69,780 in the shares of a company paying $3\frac{1}{2}$ per cent. at 77. What was his income? And how much would he gain by selling out at $77\frac{1}{8}$?

6. Find the side of a square whose area is 281 square yards 4 square feet 64 square inches.

7. Find the cube root of 16777216.

8. At what rate per cent. simple interest will Rs. 22,937-8 double itself in 25 years?

9. Define the terms *Present worth* and *Discount.*

A bill for Rs. 4,500 drawn March 3rd, at 9 months' date, is discounted by a banker on October 22nd at 5 per cent. Find his profit.

III.—Algebra.

(Time allowed, $2\frac{1}{2}$ hours.)

1. Simplify—

(*a*) $x-[2y+\{3z-3x-(x+y)\}]+2x-(y+3z)$.

(*b*) $\dfrac{x-a}{x-b}+\dfrac{x-b}{x-a}-\dfrac{(a-b)^2}{(x-a)\ (x-b)}$.

2. Find the G. C. M. of

$$5x^3-18x^2y+11xy^2-6y^3 \text{ and } 7x^2-23xy+6y^2$$

3. Find the square root of $4x^2-12xy+9y^2+4xz-6yz+z^2$.

4. Find the L. C. M. of

$$x^2+5x+6 \text{ and } x^2+6x+8.$$

5. Solve

(*a*) $\dfrac{1}{x-1}+\dfrac{2}{x-2}=\dfrac{3}{x-3}$

(*b*) $5y-3x=2$ and $8y-5x=1$.

6. Define the terms *rational quantity, surd.* When are two quantities said to be reciprocal of one another?

Divide $a^{\frac{3x}{2}}-a^{-\frac{3x}{2}}$ by $a^{\frac{x}{2}}-a^{-\frac{x}{2}}$.

Extract the square root of $18+8\sqrt{5}$.

7. Solve the equation $\sqrt{(x+11)}-\sqrt{x}=$

8. A Forest Guard starts from Dehra Dún to walk to Sahenspur, which is distant 16 miles, at the rate of $4\frac{4}{6}$ miles per hour, at the same time that another Forest Guard leaves Sahenspur for Dehra Dún, walking at the rate of a mile in 18 minutes. Find where they meet.

9. A, B and C are employed on a piece of work After 3 days A is discharged, one-third of the work having been done. After 4 days more B is discharged, another third of the work being done. C then finishes the rest of the work in 5 days. Find in how many days each could separately do the entire work.

10. A person bought a number of Rs. 200 railway shares when they were at a certain rate per cent. discount for Rs. 15,000, and afterwards when they were at the same rate per cent. premium sold them, all but 60, for Rs. 10,000. How many did he buy and what did he give for each of them.

IV.—Geometry.

(*Time allowed*, $2\frac{1}{2}$ *hours.*)

1. Define the terms *circle, centre, radius* and *diameter* of a circle; *right angle; diagonal; hypotenuse.*

2. If two straight lines cut one another, the vertically opposite angles will be equal to one another.

If four straight lines OA, OB, OC, OD, meet at a point, and AOB=COD, and BOC=DOA, prove that AOC, BOD are straight lines.

3. If two straight lines are parallel and are intersected by a third straight line, the alternate angles are equal.

The diagonals of a rhombus will bisect one another at right angles.

4. The square on the sum of two lines is greater than the sum of the squares on those lines by twice the rectangle contained by them.

AB is divided into two unequal parts in C and two equal in D. Show that the squares on AC and BC are greater than twice the rectanlge AC × CB by four times the square on CD.

5. Angles in the same segment of a circle are equal to one another.

If in any circle two equal chords intersect one another, the segments of the one are respectively equal to the segments of the other.

6. Describe a circle round a given triangle.

7. If two triangles have their angles respectively equal, they are similar, and those sides which are opposite to the equal angles are homologous.

If the diameter of a circle be one of the equal sides of an isosceles triangle, prove that its circumference will bisect the base.

N.B.—In answering the above questions either the Euclidean method or those of Modern Geometry may be followed.

V. Mensuration.

(Time allowed, 2½ hours.)

1. The sides of a triangle are respectively 22,620 and 12,815 feet, and the height is 11,484 feet. Find the base.

2. The radius of a circle is 6 feet. Find the side of a square inscribed in the circle.

3. A stick 3 feet long is placed upright on the ground, and its shadow is found to be 4 feet 6 inches long. Find the length of the shadow of a pole which is 45 feet high.

4. The chord of an arc is 20 feet and the height of the arc is 4 feet. Find the diameter of the circle.

5. A road runs round a circular shrubberry. The outer circumference is 600 feet and the inner circumference is 480 feet. Find the breadth of the road and the area it occupies.

6. Find how many planks 12 feet long by 10 inches wide will be required to floor a room which is 24 feet by 20 feet.

7. Find how many trees there are in a rectangular wood half a mile long and a quarter of a mile wide, supposing that on an average four trees grow on each square chain (1 chain = 66 feet).

8. A room is 34 feet long 18½ feet wide and 12 feet high, and its doors and windows occupy 72 square feet. Find the expense of papering the walls with paper 1½ feet wide at 10 annas per yard.

9. Find how many bricks 9 inches long 4½ inches wide and 3 inches deep will be required to build a wall 90 feet long 18 inches thick and 8 feet high.

10. Find how many cubic feet of earth must be dug out to make a well 6 feet in diameter and 30 feet deep.

11. The mast of a ship is 50 feet high; the circumference at one end is 60 inches and at the other 36. Find the number of cubic feet of wood in the mast.

APPENDIX VI.

The Final Examinations.

Mathematics. Junior Ranger's Class.

29th October, 1888. *Time* 12 *to* 3 *P. M.*

1. Write down the first fifteen prime numbers, find their sum, and resolve this sum into factors.

2. Reduce 520 acres to the decimal of a square mile; and find the value of $\cdot 26\dot{2}\dot{7} \div 1\cdot 92\dot{6}$.

3. For sál karis 10′ × 5″ × 4″ a man offers me 9½ annas a cubic foot; another man offers Rs. 15 per score karis; which offer is the highest?

4. A number consisting of two digits is equal to four times the sum of its digits; if 18 be added to the number, the digits will be inverted. Find the number.

5. Show how to find the sum of a number of terms in Arithmetical Progression; and write down the 50th term of the series 1 + 5 + 9 + &c.

6. How many boards six inches wide by twelve inches long are required to cover an area of 10 square feet? and how many yards of carpet 27 inches wide are required to cover an area of 10 feet square?

7. Find the cylindrical volume of a log 50 feet long and 9 feet in girth. If the log weighed 8½ tons, would it float in water?

8. Find the volume of a log considered as the frustum of a cone, girth at butt end 7 feet, girth at small end 5 feet 9 inches, length 25 feet.

9. Show that the cosecant of an angle in the first quadrant is never less than unity. Find the values of the sine and tangent of an angle of 30°.

10. From a ship at A a headland B was observed to bear N 25° W. After the ship had sailed 10 miles in a direction N E, the headland was observed to bear due west. Find the distance A B, given

$$\begin{aligned} \text{L sin } 45^\circ &= 9{\cdot}849485 \\ \text{L sin } 65^\circ &= 9{\cdot}957276 \\ \log\ 7802 &= 3{\cdot}892206 \end{aligned}$$

11. Define force, and show that forces may be represented by straight lines.

12. Describe the three classes of levers; and prove that the pankah coolies of the Forest School work at a mechanical disadvantage. How do they endeavour to avoid this?

MATHEMATICS. SENIOR RANGER'S CLASS.

29th September, 1888. *Time 7 to* 10 A.M.

What are "abstract," "concrete" and "prime" numbers? Find the greatest common measure of 13, 52, 416 and 78; and the least common multiple of 27, 24 and 15.

2. What are mixed circulating decimals, and how do you convert them into vulgar fractions?

Divide $1{\cdot}1\dot{3}$ by $\cdot 000\dot{1}3\dot{2}$, and reduce 10 annas 8 pies to the decimal of a rupee.

3. If 25 men can perform a piece of work in 18 days, working 8 hours a day, how many hours a day would 30 men have to work in order to perform the same piece of work in 12 days?

4. A ship worth £ 9,000 is entirely wrecked. £ 4,500 belonged to A, £ 3,000 to B, and the rest to C. What are the respective losses to A, B, and C, supposing the ship to have been insured for £ 4,500?

5. Solve the equations :—

(i). $$\frac{7x+9}{4} - \left(x - \frac{2x-1}{9}\right) = 7.$$

(ii). $$\frac{x}{5} + \frac{5}{x} = 5\tfrac{1}{5}.$$

6. Two persons, A and B, were engaged in counting rupees, and A counted 4 for every 3 counted by B. When B had counted 45 he forgot his reckoning and had to begin again, and when he had counted 24, there were no more left to count. Find the number of rupees.

7. A box with a lid is constructed of planks ¾ inch thick, and the outside measurements are 27½ inches long 16 inches wide and 12 inches high. What will the empty box weigh if the wood weighs 45 lbs. a cubic foot?

8. How many gallons of water can be contained in a cylindrical vessel 5 feet high and 3 feet diameter?

9. Find the volume of a log considered as the frustum of a cone, girth at butt end 6 feet, girth at small end 4 feet 8 inches, and length 20 feet.

10. How are angles measured in Trigonometry, and what do you understand by a negative angle?

Show how to find the value of sin 30°.

11. Show that the height of a tree is d (tan a − tan β) where d is the horizontal projection of the distance from the observer to the foot of the tree, a the angle of elevation of the top of the tree, β the angle of depression (or elevation) of the foot of the tree. How would you adapt this formula to logarithmic calculation?

MATHEMATICS, 5TH FEBRUARY, 1889.

(Special Second Examination.)

(*Time allowed, 2½ hours.*)

1. Simplify $(2\frac{5}{7}$ of $3\frac{16}{19}) + (3\frac{1}{2} \div 2\frac{5}{8}) - 9\frac{10}{21}$.

2. Reduce 18 chains 25 links to the decimal of a mile; and find the value of 3·17 of Rs. 22-8-0.

3. If 25 coolies working 8 hours a day can finish a piece of work in 40 days, how many coolies working 10 hours a day will complete the same work in 24 days?

4. A man saws up sál karis, 12′ × 5″ × 4″, and pays Rs. 15 a score royalty; another man pays 9 annas 6 pies a cubic foot for the same article; which man has the better bargain?

5. Last year the Jumna Range Officer protected an area of 31,547 acres at a cost of Rs. 847; the Ganges Range Officer an area of 45,635 acres for Rs. 1,009; the Central Range Officer 36,325 acres for Rs. 557; what was the average cost of these three Ranges in pies per acre correct to the first place of decimals; and what was the cost per acre of the cheapest of these three Ranges.

6. A cylindrical log 32 feet long and 5 feet 9 inches in girth weighs 2 tons 1 cwt 1 qr. 8¾ lbs. Will it float in water?

7. Find the weight of an empty wooden box, without a lid, 3 ft. 6 in. long 2 ft. 7½ in. wide and 1 ft. 11¼ inches high outside measurement, if the planks of which it is made are ¾ inch thick and weigh 45lbs. a cubic foot?

8. A well is to be constructed of bricks 9″ × 5″ × 4½″, and is to have an *interior diameter* of 6 feet, and the circular wall will be 2 feet thick and 20 ft. high (depth). Neglecting the mortar, find how many bricks will be required.

	I.	II.	III.	IV.	V.
1	What influence has the degree of completeness of the leaf canopy on the struggle for existence?	What are the properties of good transplants? Compare permanent and temporary nurseries.	Describe in a brief manner the uniform method and show why a special study of it is important in order to fully understand the other methods of regeneration.	Enumerate the more important technical properties of wood. On what circumstances do the relative form and size of the woody parts of a tree depend?	Describe the methods of charcoal-burning you have actually seen.
2	To what extent does the struggle for existence go on in the soil?	Give rules for the collection of seeds and their treatment before storing up or use.	Describe the preparatory stage of the uniform method.	Say what you know regarding weight as one of the properties of wood.	Describe the method of fire conservancy you have seen in the Dún and in Changamanga.
3	What influence has age and relative longevity on the struggle for existence?	How do you test seed?	Describe the seed-felling stage of the uniform method.	Ditto ditto hardness.	Describe what you saw in the Changamanga plantation.
4	What are the effects of fire on the struggle for existence?	How do you store seed?	Describe the after-operations and stage of the uniform method.	Ditto ditto flexibility and elasticity.	Describe the Lakkarkot fellings.
5	What are the effects of the action of man and the attacks of animals on the survival or predominance of species and individuals?	Describe some of the principal weak manures.	Describe the group method.	Ditto ditto aptitude for fission.	Describe the Tira coppice and the work done there.
6	How do temperature and moisture influence the survival or predominance of species and individuals?	Describe some of the principal strong manures, and explain the general difference in use and effect between strong and weak manures.	Describe strip method.	Ditto ditto strength.	Describe the coppice work at Dhan ki Darár.
7	Describe the influence of light, aspect and altitude on the struggle for existence.	How do you choose the site for a permanent nursery?	Describe jardinage.	What do you know about the shrinkage, expansion, warping and splitting of wood?	Describe and discuss the method of bamboo exploitation followed in the Saháranpur forests.
8	Ditto ditto winds and gradients.	Describe how to cultivate the soil of a nursery before it is laid out. Will subsequent general cultivation ever be necessary, and if so on what scale?	Estimate the relative practical importance in India of the various methods of natural regeneration by seed under cover.	Ditto ditto durability?	Describe what you have seen of the natural and artificial regeneration of bamboos.
9	What influence have seeding and the nature of the seed on the struggle for existence?	Describe the various ways of watering in permanent nursery, and the plan on which it should be laid out according to the mode of watering to be adopted.	How do you recognise useful advance growth, and how can it be made to contribute to the full in regeneration by seed under cover?	Say what you know regarding defects in wood.	Describe the Shahdara sissu plantation.

	I.	II.	III.	IV.	V.
10	What influence have the relative vitality and vigour of buds on the survival or predominance of species and individuals?	How are seed beds prepared and sown in a permanent nursery? In order to hasten germination, how should seeds be treated before being sown?	Describe the method of clearings.	What can you say regarding the combustibility and heating power of wood?	What principles were observed in "Mr Greig's fellings" in the Dehra Dún forests? What has been the result of those fellings?
11	What influence on the survival or predominance of species and individuals have the relative facility of throwing up root suckers, the relative duration of foliage and the season of felling and removal of produce?	What work remains to be done in a seed bed after it has been sown?	Describe the method of cleared lines and the well method.	Ditto ditto unsoundness?	Describe the system of improvement fellings carried out in the sál forests of the Dehra Dún What has been the result of these fellings?
12	Compare seedlings, stool shoots and root suckers in respect of their growth and requirements and ultimate possibilities with reference to the final composition of the crop.	What is the object of nursery lines and to what extent is their employment permissible?	Estimate the probable relative importance in India of natural regeneration by seed under cover as compared with regeneration by seed on completely cleared land.	What do you know regarding the quality of wood required for building purposes?	Describe the Deota deodár forest.
13	Show how uniformity of age leads to the predominance of only a single species and that the best guarantee for mixed growth and for the survival of weak species is intermixture of individuals of various ages.	What should be done in looking after and training seedlings in nursery lines?	How is regeneration by stool shoots effected?	For what purposes is wood used in railways, and what are the advantages and disadvantages of its employment as compared with that of iron and other material?	Describe the Deoban forests and the work carried on there.
14	What advantages are to be derived from growing mixed instead of pure crops?	How are root suckers, rhizome shoots and cuttings prepared in nurseries? Give some general ideas regarding grafting and layering.	How is regeneration effected (i) by means of root suckers; (ii) by means of stool shoots and root suckers combined?	What qualities are required in woods used for the different parts of a carriage?	Describe what you have seen of the artificial regeneration of deodár.
15	What should be the composition of (i) forests grown exclusively for the market, and (ii) those grown principally for purposes of protection?	Describe how temporary nurseries are established and managed.	How should bamboo forest be worked?	In what parts of machinery may wood be used, and when so used, what qualities should the wood possess?	Describe the Korwa coppice.
16	Under what conditions is the cultivation of pure forests justified, and what are the characteristics of auxiliary species?	How should swampy or water-logged land be prepared for sowing or planting?	Describe the system of pollarding.	What qualities in wood does a cabinet maker require?	Describe the system of export from the deodar forests of Jaunsar to the plains.
17	What are the conditions necessary for growing mixed crops, and what are the rules to observe in creating and maintaining such crops?	How do you fix drifting sands and the soil on unstable slopes?	Describe the system of stored coppice.	What qualities are required for cooper's wood?	Describe the depôt systems you have studied.

	I.	II.	III.	IV.	V.
18	Give reasons for the gregariousness of either sál, chír or sissu.	What considerations should guide one in the selection of species to sow and of the season for sowing? Describe in a few words to what extent the soil should be prepared for sowing in a forest.	Compare artificial regeneration by seed with natural regeneration by seed.	What qualities are required in woods used for packing cases?	Any one of the above seventeen questions.
19	What damage do forests suffer from fire?	Describe complete sowing with tilth. Under what conditions may we sow without cultivating the soil and how should the sowing be then effected?	Compare natural regeneration by seed with regeneration by coppice.	How is wood pulp for paper-making prepared, and what properties must the wood possess in order to furnish good pulp.	Ditto.
20	On what does the destructiveness of forest fires depend?	Describe fully the system of sowing in strips.	To what extent can and should a forester attend to the condition of the soil in an established forest?	In what relation does charcoal stand to wood in respect of its composition, transportablity and heating power? How do you recognise good charcoal?	Ditto.
21	Explain in general terms how to prevent and restrict forest fires.	Describe fully the system of sowing in patches and plots.	How do you treat a young crop from the time it is established to the time its component individuals differentiate themselves in height and vigour?	Describe the axe.	Ditto.
22	What circumstances determine the alignment and width of fire traces? Should fire traces be cleared of all the woody growth found on them?	What maintenance operations must be adopted in a young forest raised by direct sowing?	What are cleanings? When should they begin? How are they made? What is their importance in the forming of a forest crop.	Describe the saw.	Ditto.
23	What are guide lines, and how and when should they be prepared? What details should a fire-conservancy map give and what is the advantage of such a map?	In what season should planting be done? How do you lay out the ground for planting?	What are thinnings? What is the relation of ordinary thinnings to cleanings? What are the advantages secured by them and when should such thinnings begin?	Describe implements for directing the fall of trees.	Ditto.
24	When and how should a trace be fired on level ground?	How are plants packed and transported?	In what way and how frequently should thinnings be made?	How are trees felled?	Ditto.
25	Describe fire tracing in mountainous country.	Describe fully the method of ball planting.	What is a plenary thinning? Describe some of the methods of plenary thinnings.	Describe briefly how to convert trees in the forest.	Ditto.
26	What remains to be done after all the fire traces are ready, and what should be done if a fire occurred?	Describe the method of pit planting ...	Describe the object and method of pruning, showing to what extent it may be adopted by the forester. What are improvement fellings?	Give an account of the principal methods of impregnating wood.	Ditto.

Forest Law.

1 (*a*) Property : its Defintion, Classification and Acquisition ?

(*b*) What offences against the Forest itself are punished by the Forest Act ?

(*c*) On obtaining the attendance of witnesses, their testimony and expenses.

(*d*) What is a Contract ? How is a Contract started ?

2 (*a*) Definition and incidents of position ?

(*b*) What is treated of in Sections 61, 62, Forest Act, and what is the punishment prescribed ?

(*c*) What Courts can hear appeals ? In what cases is there no appeal ?

(*d*) To make a contract valid, what conditions are necessary ?

3 (*a*) On the Consequences of Possession. Adverse Possession.

(*b*) How is cattle-trespass punished ?

(*c*) What is the minimum sentence from which there may be an appeal in Summary Trials ?

(*d*) A Person making a contract must do so of his own free-will : what is meant by this ?

4 (*a*) How is property transferred ?

(*b*) Rules for the regulation of Forest produce while in transit by Land.

(*c*) Is there any appeal from an acquittal ? What convictions by 2nd and 3rd Class Magistrates are appealable ?

(*d*) What are void agreements under the Contract Act ?

5 (*a*) Servitudes. What are they ? Their Classification. Easements.

(*b*) Rules for the regulation of forest produce while in transit by Water.

(*c*) Trial of European British Subjects. The incidents of the trial.

(*d*) Discuss the performance of contracts.

6 (*a*) Acquisition of Servitudes.

(*b*) Waif Timber ; Drift Timber and its disposal.

(*c*) What provisions are there in the Forest Act to prevent Forest Officers abusing their powers ?

(*d*) Discuss the time and place of the performace of Contracts.

7 (*a*) The Extinction of Servitudes.

(*b*) What are the offences connected with a forest and its produce punishable under the Indian Penal Code ?

(*c*) What provisions are there in the Forest Act for the prevention of fires ?

(*d*) Discuss the appropriation of payments in contracts.

8 (*a*) Government Property. Give examples of property held in virtue of Ancient State Rights.

(*b*) What is the difference between Theft, Criminal Misappropriation and Criminal Breach of Trust ?

(*c*) What are the special obligations of Forest Officers under the Forest Act ?

(*d*) Are there any cases in which valid contracts need not be performed ?

9 (*a*) How is land acquired for public purposes ?

(*b*) Explain Mischief, Criminal Trespass, Attempts, Abetment.

(*c*) What are the special obligations of Forest Officers under the Penal Code ?

(*d*) How are Forest Officers enabled to make contracts on behalf of Government ?

10 (*a*) Why is a special law relating to forests required ?

(*b*) What circumstances aggravate an offence ? Can a heavier punishment be given in these cases ?

(*c*) What are the Legal powers of Forest Officers as regards Arrest, Seizure, demanding aid in cases of emergency ?

(*d*) What is a sale, and how it is effected ?

11 (*a*) In what does the constitution of a Forest Estate consist ?

(*b*) In what cases are acts that would ordinarily be offences excused ?

(*c*) What protection is extended by law to Forest Officers ?

(*d*) What practical rules should be followed when making a contract on behalf of Government ?

12 (*a*) The necessary Limitation of Forests Rights. Can Rights be excluded if a change in the Plan of Management is desired ?

(*b*) Explain the procedure in Imprisonment, Fine, Imprisonment in default of Fine.

(*c*) What are the legal powers of Forest Officers as regards compounding offences, recording evidence, conducting prosecutions ?

(*d*) What is Delivery of Goods ?

13 (*a*) Classification of Forest Rights. Grazing Rights.

(*b*) Confiscation as a punishment. What is the procedure ?

(*c*) In what capacities do Forest Officers serve ? Into what classes are they divided, and by whom appointed ?

(*d*) What do you know about titles to goods sold ?

14 (*a*) Classification of Forest Rights. Wood Rights.

(*b*) What punishments can Magistrates of the 1st, 2nd and 3rd classes severally give ? Have some Magistrates special powers ?

(*c*) What are the powers of a Forest Officer as regards use of weapons and force ?

(*d*) What do you know about the seller's goods ?

15 (*a*) Classification of Forest Rights. Rights other than grazing or Wood Rights.

(*b*) Describe the Procedure in the trial of (i) Summons Cases ; (ii) Warrant Cases.

(*c*) What special powers can a Forest Officer be invested with under the Forest Act ?

(*d*) What are Contracts of Guarantee ?

16 (*a*) Give a description of Shifting Cultivation. Is there any right to the practice as a Servitude, or any right to the soil acquired ?

(*b*) What is a Summary Trial ? What offences can be tried summarily ?

(*c*) What is meant by Reserved, Protected and Village Forests ?

(*d*) What do you know about dealing with Agents in Contracts ?

17 (*a*) Describe briefly the procedure for constituting a Reserved Forest.

(*b*) What is the procedure (i) when a Magistrate's jurisdiction appears to fail ; (ii) when he finds the case beyond his powers ?

(*c*) What is a Search Warrant ? Can they be issued by Forest Officers ?

(*d*) What do you know about Forest Officers as agents to Government in contracts ?

18 (*a*) What methods are there of providing for admitted claims to land in the area proposed to be reserved ?

(*b*) How are offences classified for police purposes ? What Magistrates can entertain complaints ?

(*c*) What are (i) Summons; (ii) Warrant Cases ? How is a Summons executed ?

(*d*) What is meant by Specific Performance of Contracts ? When can this be enforced ?

19 (*a*) Government control of Private Forests. What is the Procedure ?

(*b*) What are bailable and non-bailable offences ? To which class do most Forest offences belong ?

(*c*) How is a Warrant executed ?

(*d*) Give some account of the Stamp Act.

20 (*a*) Government control of private Forests. What is the Procedure in the following special cases :—

i.—Where mere protection may not suffice.
ii.—Where actual Government control is necessary.
iii.—Where actual expropriation is necessary.

(*b*) What are the methods of providing for admitted and defined rights at the Settlement of a Reserved Forest ?

(*c*) How should a Forest Officer deal with property in respect of which he considers a Forest offence to have been committed ?

(*d*) Give some account of the Registration Law ?

HEADS OF QUESTIONS IN ENGINEERING.

1. Admissible deviation of roads from the straight line.
2. Relative cost of earthwork, metalling, drains and bridges.
3. Numerical expression of gradient.
4. Traction force on a level road surface.
5. Traction force on an inclined road surface allowing for gravity only.
6. Traction force on inclined road surface allowing also for friction.
7. Amount of load drawn by the same traction power on different road surfaces and with various gradients.
8. Example of comparative traction force on roads of different gradients and presenting different qualities of surface.
9. Gradients for crossing ridges or ravines intersecting forest export roads.
10. Materials for road surfaces.
11. Section of road surface.
12. Macadamized roads.
13. Hill roads, gradients.
14. Limited advantage of slight gradients on hill roads.
15. Angle of repose for road cuttings.
16. Retaining walls.
17. Drainage of hill roads.
18. The outer edge of hill roads.
19. Laying out hill roads.
20. Height of floods in water-courses.
21. Blasting with gunpowder.
22. Other blasting materials.
23. Permanent way of railways and tramways.
24. Use of tramways.
25. Wire tramways.

26. Wire slides.
27. Sledge roads.
28. Dry wooden slides.
29. Wet wooden slides.
30. Water transport compared with land transport.
31. Drifting and rafting.
32. Watter-supply for drifting or rafting.
33. Sluice dams ditto.
34. Masonry dams ditto.
35. Wooden dams ditto.
36. Sluice gates ditto.
37. Supplementary tanks in broad valleys ditto.
38. Improvement of Channel ditto.
39. Weirs ditto.
40. Gratings for drifting ditto.
41. Floating booms ditto.
42. Drifting of logs in large rivers.
43. Rafting in the Black Forest.
44. Rafts on large rivers and canals.
45. Aqueducts and pipe lines for springwater for drinking purposes.
46. Wells.
47. Sinking of wells by simple methods.
48. Bull's patent dredger.
49. Building stones generally.
50. Sandstone as a building material.
51. Bricks and tiles.
52. Burning of bricks and tiles.
53. Limestone and dolomite.
54. Lime burning.
55. Ordinary mortar.
56. Hydraulic mortar and cement.
57. Concrete.
58. Crushing resistance of building materials.
59. Breaking weight of timber.
60. Safe loads for rectangular timber.
61. Effects of different distribution of load and of different ways of supporting the beams.
62. Loads on inclined beams.
63. Thrust of inclined beams or of arches.
64. Tensile strength of materials compared with their crushing resistance. Breaking weight of bent timber compared with the straight one.

ENTOMOLOGY.—*Time allowed three hours.*

FULL MARKS.

1. What is meant by a typical insect? Give reasons for selecting the Orthoptera as typical of all insects. 20

Describe the general structure of an Orthopterous insect, noticing particularly the following :—

Organs of locomotion	Reproductive system.
External sense organs	Circulatory system.
Digestive system	Respiratory system.
Nervous system	

2. What are the general conditions that conduce to preserving a forest from serious injury by insects? 10

3. What was found to be the most satisfactory method of dealing 4

FULL MARKS.

with the Longicorn teak borer in Assam? Describe the symptoms of the injury done to young trees by the borer.

4. Give the life history of Aphidæ (plant lice) and indicate the methods adopted for fighting the Phylloxera in Europe. 10

5. Give the life history of locusts and indicate the measures which have been found effective in combating them. 6

6. Give a complete account of *one* of the three following substances, and of the insects that produce it in India :— 10

a Lac.
b Silk.
c Honey.

7. Indicate the main causes that have tended to the production of the vast number of different species of insects that now exist. 10

8. What are the principal groups of insects that injure wood by boring into it? Explain the effect of removing the bark of trees that have been cut down, and also the effect of soaking the timber in water. 10

9. What are the chief points which it is useful to study in the history of any particular pest? How would you kill and preserve specimens for future reference? 7

10. Describe the part played by insects themselves in keeping down pests. 20

VEGETABLE MORPHOLOGY AND PHYSIOLOGY AND PHYSICAL SCIENCE.

The questions in these subjects were the same as those set last year.*

APPENDIX VII.

REPORT ON THE GARDENS ATTACHED TO THE FOREST SCHOOL.

The gardens at Dehra.

The following revenue has been realized and paid into the Treasury :—

		Rs.	a.	p.
From sale of mango grafts		22	14	0
Ditto	Lichi layers	24	0	0
Ditto	Vegetables to students and officers	52	14	7
Ditto	Orange grafts	5	14	0
Ditto	Loquat do.	3	8	0
Ditto	Ornamental flowering plants	25	6	6
Ditto	Chír and carob plants from Kaunli garden	12	8	0
Ditto	Grass from Ditto	6	8	0
Ditto	Grass from School and Municipality gardens	75	11	9
Ditto	Felled trees and loppings	10	8	6
Ditto	Fruit, including Rs. 20 due for sales in 1887-88 ...	180	6	2
	Total ...	420	3	6

In extending the fruit garden the following plants were used up :—

	Rs.	a.	p.
30 Lichi layers valued at	30	0	0
33 Mango grafts „	12	6	0
12 Peach „ „	3	0	0
1 Plum „ „	0	4	0
1 Apricot „ „	0	6	0
4 Orange „ „	1	8	0
Total ...	47	8	0

Moreover 90 young chír valued at Rs. 11-4-0 were given free to be planted round the Viceroy's stables. Thus the total value of the produce of the gardens was Rs. 478-15-6.

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* NOTE.—The head of questions in Vegetable Morphology and Physiology and in Physical Science were the same as in the preceding year. There was no examination in Systematic Botany.

The expenditure during year 1888 was

	Rs.	a.	p.
On account of a pakka tank	65	14	6
Ditto sand and manure	20	14	6
Ditto pots	40	11	3
Ditto carriage of plants	3	5	0
Ditto tools	3	15	0
Ditto wire and trellis work for creepers	10	2	4
Ditto posts for grapes	3	9	7
Ditto labels	10	3	11
Ditto watering the plants	103	6	6
Ditto ploughing	17	1	0
Ditto repairs to máli's quarters	4	10	0
Ditto thatch for protecting plants	14	5	6
Ditto purchase of seeds	1	7	0
Ditto stands for pots	0	12	3
Ditto tending strawberry and vegetable beds	63	3	0
Ditto wages of 4 mális	324	0	0
Ditto canal dues for both gardens	30	0	0
Ditto rent paid to Municipality	181	0	0
Ditto miscellaneous	10	0	8
Total ...	908	10	0

The expenditure thus exceeded the value of the produce obtained by Rs. 429-10-6, which is less than the corresponding figure of the preceding year by Rs. 328-2-3. Until the fruit garden comes into full bearing, there will always be a diminishing annual deficit.

The Kaunli Garden.

The following have been planted out in the open garden :—

849. *Broussonetia papyrifera*, of which 600 are surviving.

20 *Dalbergia latifolia*
81 *Pinus longifolia*
3 Teak
} To repair old failures.

3 *Eucalyptus tereticornis.*

132 Sissu.

10 *Pterocarpus Marsupium.*

80 *Albizzia Lebbek.*

Seed beds 10′ × 3½″ were formed as follows :—

Six of *Pinus longifolia*, one of teak, one of *Terminalia Chebula* and one of mango. The teak bed, which consisted of three kinds of seed supplied by the Director of Botany, Northern India, does not yet contain a single seedling. Some of the seeds may however germinate during the rains of 1889.

The plantation made in the open garden has made good progress, but it will be two or three years more before the leaf canopy will form and the plants begin to shoot up apace. It will be only then that the garden will serve properly for purposes of instruction and that an appreciable revenue will be realized.

The expenditure has been as follows :—

	Rs.	a.	p.
Canal dues	27	7	6
Rent	57	1	0
Mális' wages...	72	0	0
Total ...	156	8	6

E. E. FERNANDEZ,
Officiating Director.

ANNUAL FORM No. 58—*(Prescribed).*

FOREST DEPARTMENT, INDIA, FOREST SCHOOL, DEHRA DÚN.

Summary of Revenue of Forest School Division during 1889.

Budget Heads.	Direction.	Division.	Division.	Division.	Division.	Division.	Division.	Division.	Total.
RECEIPTS.									
I.—TIMBER AND OTHER PRODUCE REMOVED FROM THE FORESTS BY GOVERNMENT AGENCY—									
a. Timber									
b. Firewood and charcoal									
c. Bamboos									
d. Sandal-wood									
e. Grass and other minor produce ...									
II.—TIMBER AND OTHER PRODUCE REMOVED FROM THE FORESTS BY CONSUMERS OR PURCHASERS—									
a. Timber									
b. Firewood and charcoal									
c. Bamboos									
d. Grazing and fodder grass ...									
e. Other minor produce									
III.—DRIFT AND WAIF WOOD AND CONFISCATED FOREST PRODUCE—									
IV.—REVENUE FROM FORESTS NOT MANAGED BY GOVERNMENT—									
a. Duty on foreign timber and other forest produce.									
b. Revenue from shared and private forests									
V.—MISCELLANEOUS—									
a. Fines and forfeitures									
b. Refunds									
c.—Other sources	...	...	...	...	...	...	...	...	449 3 6
TOTAL RECEIPTS ...	...	...	...	...	...	...	...	...	449 3 6
A.—CONSERVANCY AND WORKS.									
I.—TIMBER AND OTHER PRODUCE REMOVED FROM THE FORESTS BY GOVERNMENT AGENCY—									
a Timber									
b. Firewood and charcoal									
c. Bamboos									
d. Sandal-wood									
e. Grass and other minor produce ...									
II—TIMBER AND OTHER PRODUCE REMOVED FROM THE FORESTS BY CONSUMERS OR PURCHASERS.									
III.—DRIFT AND WAIF WOOD AND CONFISCATED FOREST PRODUCE.									
IV.—REVENUE FROM FORESTS NOT MANAGED BY GOVERNMENT—									
a. Duty on foreign timber and other forest produce.									
b. Revenue from shared and private forests,									
V.—RENT OF LEASED FORESTS AND PAYMENTS TO SHAREHOLDERS IN FORESTS MANAGED BY GOVERNMENT.									
VI.—LIVE STOCK, STORES, TOOLS AND PLANT—									
a. Purchase of cattle									
b. Feed and keep of cattle									
c. Purchase of stores, tools and plant ...	...	...	...	...	...	...	...	...	452 5 6
VII.—COMMUNICATIONS AND BUILDINGS—									
a. Roads and bridges									
b. Buildings									
c. Other works									
VIII.—DEMARCATION, IMPROVEMENT AND EXTENSION OF FORESTS—									
a. Demarcation									
b, Compensation for land and rights ...									
c. Surveys and working plans ...									
d. Sowing and planting									
e. Protection from fire									
f. Other works									
IX.—MISCELLANEOUS—									
a. Refunds									
b. Law charges									
c. Other charges	...	...	...	...	...	...	...	...	2,563 7 10
TOTAL A.—CONSERVANCY AND WORKS ...	...	...	...	...	...	...	...	...	3,015 13 4

ANNUAL FORM No. 58—*(Prescribed).*

FOREST DEPARTMENT, INDIA, FOREST SCHOOL, DEHRA DÚN.

Summary of Expenditure of the Forest School Division during 1888-89.

Budget Heads.	Direction.	Division.	Division.	Division.	Division.	Division.	Division.	Division.	Total.
									Rs. a. p.
Brought forward, Total A.—Conservancy and Works.	...	...	...	...	...	...	...	...	3,015 13 4
B.—ESTABLISHMENT.									
1.—SALARIES—									
a. Conservators	...	...	...	...	...	...	...	...	...
b. Superior officers	...	...	...	...	...	...	...	...	21,052 1 5
c. Subordinate forest and depôt establishments.	...	...	...	...	...	...	...	...	...
d. Office establishments	...	...	...	...	...	...	...	...	1,651 7 9
e. Deputation and special allowances ...	...	...	...	...	...	...	...	...	4,016 15 11
II.—TRAVELLING ALLOWANCES—									
a Conservators	...	...	...	...	...	...	...	...	...
b. Superior officers	...	...	...	...	...	...	...	...	1,554 1 6
c. Subordinate forest and depôt establishments.	...	...	...	...	...	...	...	...	...
d. Office establishments	...	...	...	...	...	...	...	...	133 9 5
III.—CONTINGENCIES—									
a. Stationery	...	...	...	...	...	...	...	...	84 9 10
b. Carriage of tents and records ...	...	...	...	...	...	...	...	...	124 10 6
c. Rents, rates and taxes	...	...	...	...	...	...	...	...	434 7 1
d. Pay of police guards	...	...	...	...	...	...	...	...	...
e. Official postage	...	...	...	...	...	...	...	...	143 14 0
f. Sundries	...	...	...	...	...	...	...	...	749 9 9
TOTAL, B.—ESTABLISHMENTS ...	...	...	...	...	...	...	...	...	29,945 7 2
GRAND TOTAL OF EXPENDITURE ...	...	...	...	...	...	...	...	...	32,961 4 6

CALCUTTA:
The 28th May, 1889.

J. TAYLOR,
Assistant Comptroller-General (Forests).